

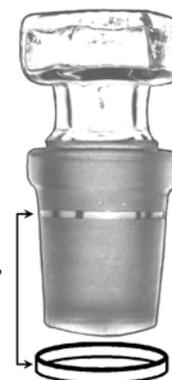
Greaseless Taper Jointed Glassware and Containers hermetic tight with new PTFE Sealing Ring

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Abstract: Greaseless glass taper joints can be sealed hermetically and at low cost with a tiny flat PTFE sealing ring (less than 1 mm wide and 0.1 mm thick, weight only 5 mg PTFE). The new sealing ring is showing outstanding low leakage and is high-vacuum tight (air leakage rate 10^{-8} ... 10^{-6} mBar*Liter/sec), solvent tight (loss of ethyl acetate out of containers < 0.1 mg/day) and resistant to fluctuation of temperature (-196 to +300 °C). The reusable PTFE sealing ring prevents joints from freezing, is thin enough to be used with joint clamps and does not need to be fixed by a groove on the glass joint. Clean and tight organometal and pharmaceutical chemistry glassware, and environmental chemistry sampling are some of the many applications.

Introduction: Taper joint grease can often not be used because it is not inert. PTFE joint sleeves are more inert and prevent joints from freezing. But there is a widespread prejudice that PTFE is too expensive and too hard for a good seal of the rough glass joint surface.

We found, however, that PTFE in the form of a new tiny sealing ring offers an amazingly good and economical seal. This result is based on the first systematic leakage measurement data on the sealing performance of different shaped PTFE taper joint seals.

Materials: The glassware contained taper joints and stoppers of standardized quality. New PTFE sealing rings (Figure 3, 4, 5, 6; Producer: Glindemann, Germany (www.glindemann.net)). The compared classic PTFE sleeves and stoppers for joint 29/32 were: Disposable PTFE sleeve without sealing ribs (BRAND, Germany, No. 51422), PTFE sleeve (socket) with two outside sealing ribs (Bohlender, Germany, No. H 930-07), PTFE sleeve (socket) with two inside sealing ribs and grip collar (BRAND, No. 51467) and PTFE stopper with two sealing ribs (BRAND, No. 144458).

Results and Discussion

Gas leakage and solvent leakage: Table 1, Figure 1 and Figure 2 show that the lowest possible leakage of all PTFE seals is performed by PTFE sealing rings. PTFE sleeves without sealing ribs have no significant sealing effect. PTFE sleeves and stoppers with sealing ribs reduce the leakage of PTFE sleeves.

The gas leakage is reduced at higher working temperature (Figure 1) when the PTFE becomes softer and, therefore, is providing a better sealing contact with the rough glass joint. The leakage is also reduced in the course of the time period after the joint was pressed together (Figure 2) because the PTFE needs time to flow under the sealing pressure to seal the leak (as shown in Figure 3 D).

The surprisingly low leakage of PTFE taper joint sealing rings can be explained by their small dimensions which provides a high sealing pressure while using only low sealing force (Figure 3). The low leakage under high pressure is indicating that both gas convection between the PTFE surface and the joint, and the gas diffusion throughout the micro-pores of PTFE are reduced.

Mass of PTFE (mg) used per seal: Small dimensions and low PTFE mass of the seal offer different advantages. A low mass of the PTFE seal (joint 29 PTFE ring 6 mg, sleeve 490...7000 mg, stopper 66000 mg, see Table 1) is not only a low cost and environmental protection factor. A small seal ring is also only a small source of contamination. PTFE is indeed chemically resistant but it is a source of substance loss (by sorption in its micro-pores) and of contamination (by desorption), for example, in trace analytical sampling. Also, the upper possible temperature limit is higher for low mass seals: The small sealing ring can be "baked" for cleaning together with the glass ware at 300°C (short term at 330°C, handle with care, degradation of PTFE can cause lung oedema). Heavy PTFE stoppers and sleeves can only be used up to 260°C because they produce much more toxic gases. This "baking" saves time in rinsing of the glass wares. Taper joints with sealing rings (Glindemann) are easy to clean. In contrary, PTFE sleeves get often stuck on the male joint part and accumulate contaminants.

Table 1: Comparison of Glindemann PTFE sealing rings with PTFE sleeves and PTFE stoppers for glass taper joints

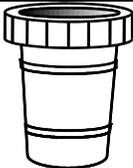
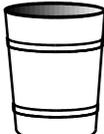
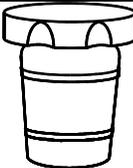
Name of seal	Sealing ring (Glindemann ⁶)	Sleeve with 2 ribs and grip collar	Sleeve with 2 ribs	Stopper (PTFE) with 2 ribs	Sleeve without ribs	Joint without sealing
Picture of seal						
Gas-leakage rate of air (mBar l / sec) (Increase of pressure in mBar per second in evacuated glass bulb, 1 liter, taper joint 29, room temperature)						
Average (n = 10)	7.5E-07	1.5E-04	1.3E-04	2.2E-03	4.5E-02	4.4E-02
Improvement (without seal =1)	58667	293	338	20	1	1
Solvent-Leakage of Ethylacetate from stoppered flasks (mg/day) (Each 10 flasks, 300 ml with taper joint 29 and stopper 29, room temperature, atmospheric pressure)						
Average (n = 10)	0.05	0.55	0.27	3.67	9.09	5.31
Improvement (without seal =1)	106	10	20	1.4	0.6	1
Other performance properties						
Mass of PTFE (mg) used per seal	6	7000	490	66000	425	
Upper temperature limit (°C)	300	260	260	260	260	450
Distance (d) of joint parts, mm (matching KECK-clamps?)	1.5 (Yes)	13 (No)	4 (No)	2.5 (No)	1.5 (Yes)	0 (Yes)

Figure 1,2,3,4, and 5, Glindemann PTFE Sealing Rings

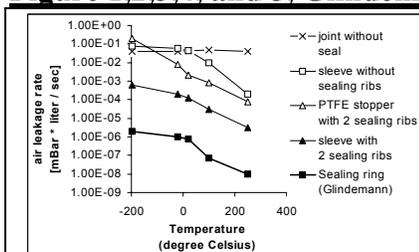


Figure 1: Temperature dependence of air leakage of PTFE joint seals

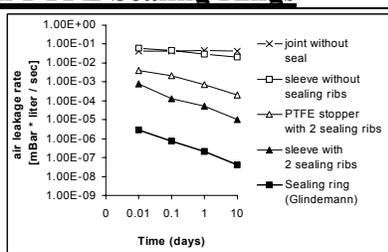


Figure 2: Time dependence of air leakage of PTFE joint seals

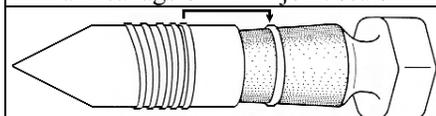


Figure 4: 50 Rings delivered on a storage tube, fitting the taper joint

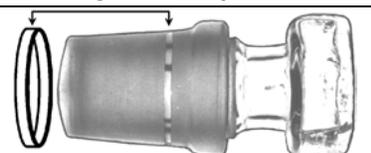


Figure 5: Good seal appears as transparent ring zone (like greased)

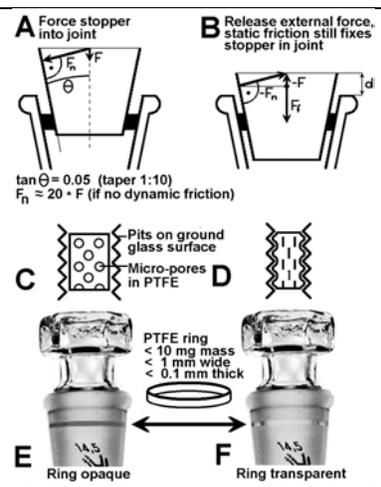


Figure 3: Press-Fit-Mechanism of PTFE Sealing Ring (Glindemann)

Figure 6: Smoothing of a narrow zone of a rough taper joint by small PTFE filings by abrasion (rub and rotate one joint part) from a PTFE ring. Left without smoothing, right a 2 mm broad smoothed zone. Sacrifice this used up sealing ring, and slip a new sealing ring on the smoothed zone, where it will produce a hermetically tight seal.



Help, if you want to test GLINDEMANN Sealing Rings

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